SWINE FEEDING EXPERIMENTS

1931

Oats for Pigs
Supplements for Pigs In Dry Lot
Making Cottonseed Meal Safe for Pigs
Full and Limited Feeding of Pigs on Forage
Preparation and Methods of Feeding Corn and Oats
Comparison of Forage Crops

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OHIO AGRICULTURAL EXPERIMENT STATION
Special Circular No. 39
MAY, 1932

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PRICES USED IN DETERMINING FEED COSTS

Ear corn	$ 0.42 per bu.
Whole oats	0.28 per bu.
Hulless oats	22.00 per ton
Hulled oats	27.60 per ton
Tankage	36.00 per ton
Menhaden fish meal	42.00 per ton
Linseed meal	36.00 per ton
Cottonseed meal, 43%	25.00 per ton
Cottonseed meal, 41%	24.00 per ton
Cottonseed meal, 36%	22.00 per ton
Soybean oilmeal	28.00 per ton
Alfalfa hay	10.00 per ton
Skimmed milk	0.15 per 100 lb.
Shelling corn	3.5¢ per bu.
Grinding corn	$ 0.10 per 100 lb.
Grinding hulled or hulless oats	0.10 per 100 lb.
Grinding oats	0.15 per 100 lb.
Grinding alfalfa hay	0.50 per 100 lb.
Salt	1.00 per 100 lb.
Pulverized limestone	0.50 per 100 lb.
Special steamed bone meal	1.50 per 100 lb.
Iron oxide	5.00 per 100 lb.
Glauber's salts	3.00 per 100 lb.
Anhydrous copper sulphate	0.80 per lb.
Potassium iodide	4.00 per lb.
Kelp	0.05 per lb.

OATS FOR PIGS

Hulless varieties of oats are those from which the hull is removed from a large share of the kernels in threshing. They are not entirely free from hulls. Those fed weighed 45.3 pounds to the bushel. A sample contained 85.1 per cent of groats and 14.9 per cent of oats with the hull on. Adding hulless oats to a ration of corn, the trio mixture, and minerals increased neither the rate of growth nor the gain produced from a given quantity of feed. At the prices used, the ground hulless oats were worth 94 per cent as much a pound as ground corn. This is a less favorable showing for them than was obtained in a previous experiment.

The hulled oats used came from the same supply as the ground oats with which they were compared. They were hulled on a farm-type huller. The variety and source of the oats were not known, but they were more difficult to hull than are some varieties. A sample of the hulled oats, as fed, contained 76.6 per cent of groats or hulled oats and 23.4 per cent of unhulled oats and oat hulls, chiefly the former. As fed, the hulled oats represented 63.4 per cent of the original weight of the oats. Assuming that the worth of the oat hulls would offset the hulling charge, the cost of the hulled oats, before they were ground, was $1.38 per hundred pounds when oats were figured at 28 cents a bushel.

The pigs getting hulled oats along with corn, the trio mixture, and minerals made faster gains and more gain per unit of feed than those getting unhulled oats, but the ration containing the hulled oats was no more efficient than a similar one without them.

Oats of the 1930 crop were usually of excellent quality. Those fed tested 35.2 pounds to the bushel. A sample contained 27.8 per cent of hulls and 72.2 per cent of groats. The ground oats, without the hull removed, were fed at the rate of 1.5 pounds for each pound of supplement and minerals. This averaged a little over a pound of oats for every 3 pounds of corn. In spite of their heavy weight and the relatively small percentage used, the addition of oats to the ration resulted in slowing down the rate of growth and increasing the feed required per unit of gain.

Omitting linseed meal from the supplemental mixture, when oats were included in the ration, was tried. The pigs without linseed meal failed to gain as rapidly but made as much gain from a given amount of feed as those receiving linseed meal in their ration.

Other tests with oats are reported in the Bimonthly Bulletins for September-October 1928 and July-August 1930 and in Special Circulars 17 and 32.

TABLE 1.—Oats for Pigs

Experiment started Dec. 17, 1930 Feeds mixed and self-fed	1 Corn Tankage Linseed meal Ground alfalfa Minerals	2 Corn **Hulless oats** Tankage Linseed meal Ground alfalfa Minerals	3 Corn **Hulled oats** Tankage Linseed meal Ground alfalfa Minerals	4 Corn **Ground oats** Tankage Linseed meal Ground alfalfa Minerals	5 Corn Ground oats Tankage Ground alfalfa Minerals
Number of pigs	14	14	14	14	14
Initial weight per pig, lb.	63.9	63.9	64.2	63.7	63.9
Final weight per pig, lb.	200.2	199.8	201.8	203.7	202.9
Average daily gain, lb.	**1.15**	**1.13**	**1.16**	**1.05**	**0.99**
Days required to gain 135 lb.	118	120	117	129	137
Daily feed per pig, lb.:					
Corn	3.97	3.18	3.21	3.05	3.03
Oats	.....	0.96	0.97	1.10	0.92
Tankage	0.41	0.34	0.34	0.35	0.42
Linseed meal	0.20	0.17	0.17	0.17	.....
Ground alfalfa	0.14	0.15	0.15	0.15	0.14
Minerals	0.06	0.06	0.06	0.06	0.06
Total	**4.78**	**4.86**	**4.90**	**4.88**	**4.57**
Feed per 100 lb. gain, lb.:					
Corn	346.43	281.01	277.24	290.10	307.58
Oats	.....	84.61	83.51—	104.36	93.60
Tankage	35.61	30.20	29.84	33.39	42.93
Linseed meal	17.80	15.10	14.92	16.69	.....
Ground alfalfa	12.52	12.88	12.71	13.92	13.91
Minerals	5.01	5.58	5.51	5.57	5.56
Total	**417.37**	**429.38**	**423.73**	**464.03**	**463.58**
Cost of feed per 100 lb. gain	$4.26	$4.47	$4.71	$4.77	$4.65

Lot 2—A 159.5-lb. pig was taken out on March 25, 1931.
Lot 5—A 91-lb. pig was taken out on January 27, 1931.
Minerals: Salt, 19.4; limestone, 77.6; iron oxide, 2.97; potassium iodide, 0.03.

FISH MEAL AND KELP FOR FALL PIGS

Menhaden fish meal containing 60 per cent of protein was fed. Since, in a trial the preceding year, a pig in each of two lots fed simple rations of corn and fish meal became slightly crampy before the close of the test, 3 per cent of ground alfalfa was included in the ration in the present experiment. Corn and fish meal or corn, fish meal, and ground alfalfa have produced faster gains in three out of four trials and greater gains from a given amount of feed in all four trials than corn, the trio mixture, and minerals.

As determined by 16 experiments at a number of stations, the average worth of fish meal was 17 to 23 per cent greater than that of tankage for dry-lot feeding. The range is due to their comparative values varying with changes in the price relationships of the grain and supplement in the respective rations. For pigs on pasture the average worth of fish meal was only slightly greater than that of tankage.

A mixture of equal parts of fish meal and tankage was less effective for feeding with corn and ground alfalfa than was a supplement of fish meal alone.

No fishy flavor was detected in samples of meat from hogs fed fish meal.

Dried kelp was tried at the rate of 1.5 per cent of the total ration. As in the test the preceding year in which the dried kelp was fed at a 2.5 per cent level, or a level supplying as much total ash as the check ration, the pigs receiving it made slower gains and less gain per unit of feed than those on a similar ration containing no kelp but containing a small amount of iron oxide and a minute quantity of potassium iodide.

TABLE 2.—Fish Meal and Kelp for Fall Pigs

Experiment started Dec. 17, 1930 Feeds mixed and self-fed	1 Corn Tankage Linseed meal Ground alfalfa Minerals	2 Corn Tankage Linseed meal **Kelp** Ground alfalfa Limestone	3 Corn **Menhaden fish meal** Ground alfalfa Salt	4 Corn **Menhaden fish meal** **Tankage** Ground alfalfa Salt
Number of pigs	14	14	13	14
Initial weight per pig, lb.	63.9	63.8	64.1	63.9
Final weight per pig, lb.	200.2	205	198.6	201.6
Average daily gain, lb.	**1.15**	**1.04**	**1.20**	**1.09**
Days required to gain 135 lb.	118	130	113	124
Daily feed per pig, lb.:				
Corn	3.97	3.86	4.07	3.84
Fish meal	.....	.....	0.52	0.24
Tankage	0.41	0.39	.....	0.24
Linseed meal	0.20	0.19	.....	.....
Kelp	.....	0.07	.....	.....
Ground alfalfa	0.14	0.14	0.14	0.13
Salt or minerals	0.06	0.01	0.02	0.02
Total	**4.78**	**4.66**	**4.75**	**4.47**
Feed per 100 lb. gain, lb.:				
Corn	346.43	372.77	339.05	351.26
Fish meal	.....	.....	43.21	21.90
Tankage	35.61	37.36	.....	21.90
Linseed meal	17.80	18.68	.....	.....
Kelp	.....	6.76	.....	.....
Ground alfalfa	12.52	13.51	11.87	12.27
Salt or minerals	5.01	1.35	1.58	1.64
Total	**417.37**	**450.43**	**395.71**	**408.97**
Cost of feed per 100 lb. gain	$4.26	$4.86	$4.11	$4.17

Lot 1 is the same as Lot 1 in the preceding table. The lots in the two tables are comparable.

Minerals: Salt, 19.4; limestone, 77.6; iron oxide, 2.97; potassium iodide, 0.03.

Lot 2—A 76-lb. pig was taken out on February 11.

SUPPLEMENTS TO CORN FOR DRY-LOT FEEDING

The pigs used in this experiment were farrowed early, between February 1 and 22, so that, in spite of being fed in a dry lot, they could be exhibited as a demonstration and their data presented at the State Fair. A summary of nine experiments reported in Ohio Agricultural Experiment Station Bulletin 488 showed the mixture of tankage 2, linseed meal 1, and ground alfalfa 1 to be superior to tankage alone as a supplement to corn for pigs in dry lot. Dry-rendered tankage differs from ordinary or steam-rendered tankage in that no water or steam is injected into the material during the process of manufacture. It is lighter in color and has a pleasant aroma rather than a disagreeable odor. That used was obtained from Armour and Company and contained 60 per cent of protein. The fish meal fed had approximately the same protein content.

Since the good results from feeding skimmed milk are well known, one lot getting skimmed milk as a supplement was included so that the performance of the other groups could be compared with that of the milk-fed lot. The skimmed milk was fed at the rate of 8 pounds daily a head, divided into two feedings. Otherwise, the supplements and the shelled corn were self-fed and kept in separate compartments of the self feeders. The supplemental mixtures for Lots 2 and 3 consisted of tankage 2, linseed meal 1, and ground alfalfa 1.

All four lots made excellent showings, both in the rapidity of the gains and in the amount of gain produced from a given quantity of feed. At the prices used and considering only the feed required per unit of gain, approximately 11.5 pounds of milk were equal in feeding value to 1 pound of tankage. The dry-rendered tankage as used was worth 14 per cent more than the ordinary or steam-rendered tankage. The superiority of fish meal to the trio supplemental mixture for dry-lot feeding was again demonstrated.

TABLE 3.—Supplements to Corn for Dry-lot Feeding

Experiment started May 13, 1931	1 Shelled corn **Skimmed milk**	2 Shelled corn **Tankage** **Linseed meal** **Ground alfalfa**	3 Shelled corn **Dry-rendered tankage** **Linseed meal** **Ground alfalfa**	4 Shelled corn **Menhaden fish meal**
Number of pigs	7	8	8	8
Initial weight per pig, lb.	72.7	71.7	71.5	72.4
Final weight per pig, lb.	226.7	214.0	222.4	216.9
Average daily gain, lb.	**1.54***	**1.36**	**1.44**	**1.47**
Days required to gain 150 lb.	98	111	105	102
Daily feed per pig, lb.:				
Shelled corn	4.50	4.51	4.72	4.89
Skimmed milk	8.00			
Tankage or fish meal		0.31	0.32	0.42
Linseed meal		0.16	0.16	
Ground alfalfa		0.16	0.16	
Total	**5.38†**	**5.14**	**5.36**	**5.31**
Feed per 100 lb. gain, lb.:				
Shelled corn	313.14	332.93	328.58	331.46
Skimmed milk	556.14			
Tankage or fish meal		23.07	22.39	28.73
Linseed meal		11.54	11.19	
Ground alfalfa		11.54	11.19	
Total	**374.31†**	**379.08**	**373.35**	**360.19**
Cost of feed per 100 lb. gain	$3.38	$3.41	$3.36	3.30

The shelled corn and protein supplements were self-fed separately. The skimmed milk was fed twice daily. The supplements for Lots 2 and 3 consisted of tankage 2, linseed meal 1, and ground alfalfa 1.

*Average daily gain given is that of the six pigs which were in the lot at the close of the test. A 115-pound pig was taken out after 12 weeks. With this pig included, the average daily gain was 1.44 lb.

†With skimmed milk reduced to 10 per cent moisture.

COTTONSEED MEAL FOR PIGS

Two earlier trials with cottonseed meal were reported in Special Circular 32. In the present trial, ordinary cottonseed meal and a special meal developed by the Procter & Gamble Company, who cooperated in a part of the project, were again compared. The rations used are shown in Table 4. The two meals contained 43 per cent of protein and were from Arkansas. Lot 11 was fed a 36 per cent protein meal, from South Carolina, which was made by the expeller process. The remainder of the various rations, aside from the supplements, was made up of yellow corn, ground alfalfa, and minerals.

When used as the only protein supplement, the 43 and 36 per cent cottonseed meals were fed at 20 and 25 per cent levels, respectively, until the pigs averaged 120 pounds in weight; thereafter, the meals were fed at 15.7 and 20 per cent levels, respectively. Five pigs out of eight in each of the two lots died during the experiment.

Moistening and autoclaving or cooking the 43 per cent meal with steam at 14 pounds pressure for a half hour reduced the death losses to two out of eight.

No ill effects were observed and no deaths occurred when the ordinary, untreated, 43 per cent protein meal was fed at lower levels and tankage or a mixture of tankage and cocoanut meal was included in the ration.

A surprising feature of the test was that there were no deaths among the pigs receiving the ration containing tankage at a 7.9 per cent level and the ordinary, untreated, 43 per cent protein cottonseed meal at a high, or 20 per cent, level. This was in striking contrast to a mortality of 62.5 per cent caused by meal from the same supply and fed at a slightly lower level in a similar ration without the tankage.

None of the pigs receiving the special cottonseed meal died, regardless of the manner in which it was fed.

Linseed meal was satisfactory for feeding with tankage at both the 4.6 and the 15.8 per cent levels. Other tests have shown that additional minerals and vitamins, particularly vitamin D, are needed with yellow corn and linseed meal but that the ration is safe, as well as reasonably effective, when these deficiencies are corrected.

TABLE 4.—Cottonseed Meal for Pigs

Experiment started July 1, 1930 Feeds mixed and self-fed	1 Corn Autoclaved cottonseed meal Ground alfalfa Minerals	2 Corn Cottonseed meal Ground alfalfa Minerals	3 Corn Cottonseed meal Tankage Ground alfalfa Minerals	4 Corn Cottonseed meal Tankage Copra Ground alfalfa Minerals	5 Corn Cottonseed meal Tankage Ground alfalfa Minerals	6 Corn Special cottonseed meal Ground alfalfa Minerals	7 Corn Special cottonseed meal Tankage Ground alfalfa Minerals	8 Corn Special cottonseed meal Tankage Copra Ground alfalfa Minerals	9 Corn Tankage Linseed meal Ground alfalfa Minerals	10 Corn Tankage Linseed meal Ground alfalfa Minerals	11 Corn Cottonseed meal* Ground alfalfa Minerals
Average per cent of cottonseed meal or linseed meal in ration	**18.3**	**19.0**	**7.1**	**10.5**	**20.0**	**18.0**	**7.1**	**10.7**	**15.8**	**4.6**	**23.1**
Number of pigs at start	8	8	8	8	8	8	8	8	8	7	8
Number of removals	1	0	0	1	1	0	0	1	0	0	0
Number of deaths	2	5	0	0	0	0	0	0	0	0	5
Initial weight per pig, lb.	44.4	44.7	44.7	44.2	46.1	44.4	44.3	43.9	45.0	45.5	43.9
Final weight per pig, lb.	198.3	196.3	196.1	204.3	210.3	195.0	196.0	200.2	203.3	212.0	209.8
Average daily gain, lb.	**0.69**	**0.55**	**0.90**	**0.99**	**1.02**	**0.90**	**0.94**	**0.90**	**1.03**	**1.08**	**0.60**
Daily feed per pig, lb.:											
Corn	2.86	2.28	3.26	3.29	2.96	3.13	3.46	3.03	3.17	3.70	2.29
Cottonseed meal	0.69	0.58	0.29	0.46	0.89	0.74	0.305	0.43	.....	.....	0.74
Tankage	.....	.....	0.29	0.15	0.35	.....	0.305	0.15	0.17	0.424	.....
Copra oilmeal or linseed meal	.....	.....	.....	0.26	.....	.....	.....	0.24	0.67	0.212	.....
Ground alfalfa	0.11	0.09	0.12	0.13	0.13	0.12	0.13	0.12	0.12+	0.14	0.10
Minerals	0.10	0.08	0.08	0.10	0.09	0.11	0.09	0.09	0.09	0.09	0.08
Total	**3.76**	**3.03**	**4.04**	**4.39**	**4.42**	**4.10**	**4.29**	**4.06**	**4.22**	**4 57**	**3.21**
Feed per 100 lb. gain, lb.:											
Corn	415.24	416.85	361.86	331.43	291.76	349.66	367.19	338.30	308.32	342.46	381.84
Cottonseed meal	99.76	105.12	31.63	46.54	87.09	82.57	32.40	48.36	.....	.....	123.75
Tankage	.....	.....	31.63	15.51	34.40	.....	32.40	16.12	16.27	39.216	.....
Copra or linseed meal	.....	.....	.....	26.59	.....	.....	.....	27.21	65.08	19.608	.....
Ground alfalfa	16.37	16.59	13.37	13.29	13.06	13.74	13.66	13.61	12.33	12.67	16.07
Minerals	14.18	14.38	9.36	9.75	9.15	11.90	9.56	9.98	9.04	8.45	13.93
Total	**545.55**	**552.94**	**447.85**	**443.11**	**435.46**	**457.87**	**455.21**	**453.58**	**411.04**	**422.40**	**535.59**
Cost of feed per 100 lb. gain	$ 5.36	$ 5.44	$ 4.50	$ 4.39	$ 4.60	$ 4.49	$ 4.57	$ 4.49	$ 4.50	$ 4.40	$ 5.16

*Expeller cottonseed meal from South Carolina containing 36% of protein. The other two cottonseed meals were from Arkansas and contained 43% of protein. The cottonseed meal fed Lot 1 was autoclaved for ½ hour at 14 pounds pressure.

The pigs removed from Lots 1, 4, 5, and 8 were taken out after 14, 56, 56, and 112 days and weighed 42.5, 48.5, 48.5, and 58.5 lb. each, respectively.

Minerals: Salt, 19.37; limestone, 38.8; special steamed bone meal, 38.8; iron oxide, 2.8; anhydrous copper sulphate, 0.2; potassium iodide, 0.03.

MAKING COTTONSEED MEAL SAFE FOR PIGS

To secure further data concerning the beneficial effect of feeding tankage with cottonseed meal a group of 12 pigs was fed a ration containing tankage at an 8 per cent level and cottonseed meal at a high, or 20 per cent, level. No lot was fed cottonseed meal, at a similar level, as the only high protein feed in the ration, but a mixture of meals used in previous tests, containing approximately 41 per cent of protein and known to be toxic, was fed. The 12 pigs remained thrifty throughout the experiment.

Some of the pigs in the other lots failed to thrive from the beginning or became unthrifty during the test, apparently from causes other than the ration received. The number removed from each lot is shown in Table 5, and the weight of each pig when it was taken out is given in a footnote included with the table.

One pig out of 13 in a lot receiving an average of 15.7 per cent of cottonseed meal and 13.5 per cent of ground hulled oats along with yellow corn, ground alfalfa, and minerals died during the experiment. It was not lacking in thrift and, until shortly before its death, was one of the better gaining pigs in the lot.

A supplemental mixture of equal parts cottonseed meal and soybean oilmeal gave fully as good results as the mixture of tankage 2, linseed meal 1.

Probably because of unthrifty pigs during the fore part of the test, for which the ration was not considered responsible, soybean oilmeal, when fed as the only protein concentrate, failed to make as good a relative showing as it made in tests reported in Bulletin 452. Good quality soybean oilmeal is an efficient source of protein.

Although it proved fairly satisfactory, cottonseed meal, in this test, was hardly as effective as linseed meal for use in the trio supplemental mixture.

TABLE 5.—Making Cottonseed Meal Safe for Pigs

Experiment started January 13, 1931 Feeds mixed and fed twice daily	1 Corn **Tankage** **Cottonseed meal** Ground alfalfa Minerals	2 Corn **Tankage** **Cottonseed meal** Ground alfalfa Minerals	3 Corn **Ground hulled oats** **Cottonseed meal** Ground alfalfa Minerals	4 Corn **Soybean oilmeal** **Cottonseed meal** Ground alfalfa Minerals	5 Corn **Soybean oilmeal** Ground alfalfa Minerals	6 Corn **Tankage** **Linseed meal** Ground alfalfa Minerals
Per cent of cottonseed meal	**20**	**4.1**	**15.7**	**7.9**		
Pigs at start	12	13	13	13	13	13
Number of removals	0	1	3	1	3	2
Number of deaths	0	0	1	0	0	0
Initial weight per pig, lb	52.7	52.5	52.8	52.8	52.7	53.3
Final weight per pig, lb	213.7	214.1	219.3	217.6	212.1	215.3
Average daily gain, lb	**1.15**	1.11	**0.84**	**1.15**	**0.88**	**1.15**
Days required to gain 160 lb	139	145	191	139	181	139
Daily feed per pig, lb.:						
Corn	3.31	3.85	2.55	3.65	3.03	3.85
Tankage or hulled oats	0.39	0.38	0.53			0.41
Cottonseed or linseed meal	0.98	0.19	0.61	0.366		0.21—
Soybean oilmeal				0.366	0.55	
Ground alfalfa	0.15	0.14	0.12	0.14	0.12—	0.14
Minerals	0.07	0.07	0.10	0.12	0.10	0.07
Total	**4.90**	**4.63**	**3.91**	**4.64**	**3.80**	**4.68**
Feed per 100 lb. gain, lb.:						
Corn	287.21	348.02	304.15	317.77	343.04	333.80
Tankage or hulled oats	34.04	34.25	62.73			35.41
Cottonseed or linseed meal	85.10	17.13	73.33	31.90		17.71
Soybean oilmeal				31.90	62.28	
Ground alfalfa	12.76	12.55	13.99	12.13	12.88	12.15
Minerals	6.38	6.27	12.12	10.51	11.16	6.08
Total	**425.49**	**418.22**	**466.33**	**404.21**	**429.36**	**405.15**
Cost of feed per 100 lb. gain	$4.44	$4.18	$4.86	$3.97	$4.25	$4.18

Minerals: Salt, 19.37; limestone, 38.8; special steamed bone meal, 38.8; iron oxide, 2.8; anhydrous copper sulphate, 0.2; potassium iodide, 0.03.

Lot 2, a 49-lb. pig taken out March 24; Lot 3, 102-lb. pig died March 17; 65.5-lb. pig taken out April 7; 63.5- and 90-lb. ones taken out April 21; Lot 4, 52.5-lb. pig taken out February 24; Lot 5, a pig weighing 52.5 and one weighing 51 lb. were taken out April 7; a 57-lb. one was taken out April 21; Lot 6, an 83.5-lb. pig and one weighing 66.5 lb. were taken out April 21.

COTTONSEED MEAL, AT HIGH AND LOW LEVELS, WITH TANKAGE

Cottonseed meal was fed as a substitute for linseed meal in the trio supplemental mixture or at a low level and also at a high level, with tankage, in this experiment. None of the nine pigs getting tankage and 20 per cent of cottonseed meal in the ration died during the experiment. They gained only 85 per cent as rapidly, however, as those receiving a similar ration containing 4 per cent of cottonseed meal.

Whether the cottonseed meal used would have proved toxic if fed as the only high-protein feed was not determined.

TABLE 6.—Cottonseed Meal, at High and Low Levels, with Tankage for Pigs in Dry Lot

	Corn, ground **Tankage** **Cottonseed meal** Ground alfalfa Minerals	Corn, ground **Tankage** **Cottonseed meal** Ground alfalfa Minerals
Per cent of cottonseed meal fed	**20**	**4**
Pigs at start	9	9
Number of deaths	0	0
Initial weight per pig, lb.	81.8	82.2
Final weight per pig, lb.	218.3	214.8
Average daily gain, lb.	**1.15**	**1.35**
Days required to gain 150 lb.	131	111
Daily feed per pig, lb.:		
Corn	3.33	4.69
Tankage	0.39	0.44
Cottonseed meal	0.99	0.22
Ground alfalfa	0.15	0.17
Minerals	0.07	0.08
Total	**4.93**	**5.60**
Feed per 100 lb. gain, lb.:		
Corn	290.50	346.19
Tankage	34.43	32.86
Cottonseed meal	86.07	16.43
Ground alfalfa	12.91	12.43
Minerals	6.46	6.21
Total	**430.37**	**414.12**
Cost of feed per 100 lb. gain	$4.49	$4.13

The cottonseed meal used was sold to contain 41 per cent of protein.
Minerals: Salt, 19.37; limestone, 38.8; special steamed bone meal, 38.8; iron oxide, 2.8; anhydrous copper sulphate, 0.2; potassium iodide, 0.03.

FULL AND LIMITED FEEDING ON RAPE PASTURE

Limited-fed pigs as a rule make more gain from a given amount of feed or concentrates but gain more slowly and require more forage than full-fed ones. Since hog prices usually decline in the fall as receipts increase, the saving in feed from limited feeding is ordinarily more than offset by the lower selling price received.

Unfortunately an equal number of pigs per acre was started in each lot. Those on a limited allowance of grain ran short of forage during the fore part of September. On September 22 they were moved to plots of rape previously grazed by other pigs, but by October 20 practically no rape was left, and they were transferred to blue grass. Although abundant, the blue grass was apparently worth much less than rape. On the rape and on the blue grass their feed requirement was 8.3 per cent lower and 8.3 per cent higher, respectively, than that of the full-fed pigs when of corresponding weights. For the entire test the limited-fed pigs consumed within 2.3 per cent as much feed as the full-fed ones. In six other trials the limited-fed pigs consumed from 20 to 82 pounds, or from 5.4 to 20.1 per cent less, feed per 100 pounds gain than the full-fed pigs.

That Lot 4 had very little green feed after September 22 when they weighed 121 pounds probably accounts for the poorer relative showing from limited feeding at first and full feeding later in this than in previous tests. In the earlier tests limited feeding to a weight of approximately 125 pounds and full feeding thereafter usually proved more profitable than full feeding for the entire time.

Limited feeding at first and full feeding later is advisable only under rather limited conditions. Early farrowed, well-bred, thrifty pigs, excellent forage, and skillful feeding and management are necessary for it to prove more profitable than full feeding for the entire time.

In accord with trials reported in Bulletin 355 self-fed pigs made a little faster gains but required slightly more feed per unit of gain than similar pigs full-fed twice daily.

Regardless of whether it was self- or hand-fed the advantage of shelled corn over ear corn was not sufficient to cover the cost of shelling.

TABLE 7.—Full and Limited Feeding of Spring Pigs on Rape Pasture

Experiment started June 16, 1931	1 Ear corn Tankage Full feed twice daily	2 Shelled corn Tankage Self-fed separately	3 Shelled corn Tankage Full feed twice daily	4 Shelled corn Tankage Limited feed at first; full feed later	5 Shelled corn Tankage Limited feed entire time
Acres of forage	1.0	1.0	1.0	1.0	1.5
Number of pigs	19	20	19	20	20
Initial weight per pig, lb.	52.0	52.6	52.3	52.0	52.1
Final weight per pig, lb.	201.6	204.2	206.7	209.9	198.9
Average daily gain, lb.	**1.18**	**1.32**	**1.23**	**1.06**	**0.86**
Days required to gain 150 lb.	127	114	122	142	175
Daily feed per pig, lb.:					
Corn, shelled basis	3.92	4.38	4.00	3.42	2.78
Tankage	0.30	0.32	0.30	0.24	0.21
Total	**4.22**	**4.70**	**4.30**	**3.66**	**2.99**
Daily feed per 100 lb. liveweight, lb.	3.33	3.66	3.32	2.79	2.38
Feed per 100 lb. gain, lb.:					
Corn, shelled basis	332.83	331.17	326.39	322.33	323.02
Tankage	25.95	24.04	24.66	22.36	24.10
Total	**358.78**	**355.21**	**351.05**	**344.69**	**347.12**
Cost of feed per 100 lb. gain	$2.96	$3.12	$3.10	$3.02	$3.06
Cost of feed and pasture per 100 lb. gain	$3.52	$3.70	$3.61	$3.61	$3.84
Gain of 150 lb. made by	Oct. 21	Oct. 8	Oct. 16	Nov. 5	Dec. 8
Selling price (Chicago 1924-1931, weekly av.)	$9.86	$10.07	$9.86	$9.31	$8.82

Lot 1—A 46-lb. pig was taken out June 30.
Lot 2—A 55- and a 67-lb. pig were taken out June 30, and a 73.5-lb. one July 28.
Lot 4—Four pigs, weighing 63, 56, 63, and 54 lb., respectively, were taken out June 30.
Lot 5—A 51-lb. pig was taken out June 30 and a 60-lb. one July 28.
Rape was valued at $15 an acre. Lot 5 used approximately 1.25 acres of rape and 0.25 acre of blue grass. The blue grass was charged at $8 an acre.

PREPARATION AND METHOD OF FEEDING CORN

Ground corn, fed both dry and moist or as a slop, shelled corn, and ear corn were compared in an earlier experiment which is reported in Table 8. All of the lots were on rape pasture, were given tankage as a supplement, and were full-fed twice daily.

Practically the same amount of corn was consumed per unit of gain whether it was shelled or fed as ear corn. On the basis of the feed required per pound of gain, ground corn, when fed dry, was worth 3 cents more a bushel than ear corn. The pigs given ground corn ate a trifle more feed and were ready for market 9 days earlier than those given ear corn. Nothing was gained by wetting the ground corn and feeding it as a slop.

TABLE 8.—Preparation and Method of Feeding Corn to Pigs on Rape Pasture

	1 Ear corn Tankage	2 Shelled corn Tankage	3 Ground corn Tankage Fed dry	4 Ground corn Tankage Moistened
Number of pigs	6	6	6	6
Initial weight per pig, lb.	49.1	49.3	48.7	48.7
Final weight per pig, lb.	199.5	205.7	201.2	202.2
Average daily gain, lb.	**1.25**	**1.17**	**1.36**	**1.29**
Days required to gain 150 lb.	120	128	111	117
Daily feed per pig, lb.:				
Corn, shelled basis	4.32	4.01	4.46	4.17
Tankage	0.30	0.30	0.30	0.30
Total	**4.62**	**4.31**	**4.76**	**4.47**
Feed per 100 lb. gain, lb.:				
Corn, shelled basis	344.69	341.05	327.56	323.17
Tankage	23.92	25.52	22.04	23.24
Total	**368.61**	**366.57**	**349.60**	**346.41**
Cost of feed per 100 lb. gain	$3.02	$3.23	$3.39	$3.37
Cost of feed and pasture per 100 lb. gain	$3.43	$3.63	$3.80	$3.77

FULL AND LIMITED FEEDING ON PASTURE WITH LIMITED-FED PIGS FINISHED IN DRY LOT

Full-fed spring pigs, aside from those farrowed exceptionally late, will reach a market weight before the close of the grazing season. On the other hand, unless they are farrowed early, pigs given a limited amount of grain on pasture will not be ready for market by the close of the grazing season and so must be finished without forage or in dry lot. To correspond with these conditions, a group of pigs, self- or full-fed on rape pasture until they averaged approximately 200 pounds in weight, was compared with one given a limited amount of feed on rape pasture for 18 weeks and then full-fed in dry lot twice daily for 5 weeks, or until they reached a similar final weight.

For the first 14 weeks of the test dry-rendered tankage was fed. The full-fed pigs having shelled corn and tankage before them in separate compartments of a self feeder took a pound of dry-rendered tankage for every 6 pounds of corn consumed.

The pigs that were given a limited allowance of grain on pasture and finished in dry lot required more feed per unit of gain than those that were full-fed and finished on pasture. Assuming that new corn was fed after October 6, the full-fed pigs would have utilized 71 per cent of old and 29 per cent of new corn and the limited-fed pigs, 36 and 64 per cent of old and new corn, respectively. For the 8-year period from 1923 to 1930, the average farm price of corn per bushel, according to the Year Books of the U. S. Department of Agriculture, was 95.3 cents for August and 76.6 cents for November. Using these figures as the price of old and new corn and charging the tankage at $60 a ton and the pasture at $15 an acre would make the feed and pasture cost per 100 pounds of gain for the full- and for the limited-fed pigs $6.56 and $6.26, respectively.

The average weekly prices for hogs in Chicago during the same years, 1923-1930, for the weeks in the year when the full-fed and the limited-fed pigs were ready for market were $9.74 and $9.16 per 100 pounds, respectively. The lower selling price of limited-fed pigs must be accepted on their entire weight rather than merely on their gains during the experimental period. At the prices just

given, the returns, per 100 pounds of gain, above the feed and pasture costs and the loss in value sustained on the original weight of the limited-fed pigs would have been $3.18 on the full-fed pigs and $2.69 on the limited-fed pigs.

TABLE 9.—Full and Limited Feeding on Rape Pasture with Limited-fed Pigs Finished in Dry Lot

	1	2	2	
	Shelled corn Tankage **Self-fed separately**	Shelled corn Tankage **Limited feed**	Grazing period	Dry-lot period
Acres of forage	0.5	0.625	0.625	.....
Number of pigs	10	8	8	8
Initial weight per pig, lb	45.5	45.6	45.6	132.1
Final weight per pig, lb	202.0	198.4	132.1	198.4
Average daily gain, lb.	**1.32**	**0.93**	**0.69**	**1.77**
Days required to gain 150 lb	114	162	.....	.....
Daily feed per pig, lb.:				
Shelled corn	4.07	3.04	2.10	6.28
Tankage	0.50	0.25	0.21	0.41
Total	**4.57**	**3.29**	**2.31**	**6.69**
Feed per 100 lb. gain, lb.:				
Shelled corn	307.23	326.50	302.83	354.25
Tankage	38.28	27.46	30.65	23.06
Total	**345.51**	**353.96**	**333.48**	**377.31**
Cost of feed per 100 lb. gain	$3.19	$3.15	$3.01	$3.29
Cost of feed and pasture per 100 lb. gain	$3.67	$3.87	$4.25	.....

METHODS OF FEEDING OATS TO PIGS ON RED CLOVER PASTURE

In this experiment oats were fed in various ways, along with corn and tankage, to pigs on clover pasture. Dry-rendered tankage was fed for 14 weeks and steam-rendered tankage for the remaining 3 weeks of the test. Both contained approximately 60 per cent of protein. The dry-rendered tankage was exceptionally palatable. While it was being fed, the pigs in Lots 1 and 4, having access to it in separate compartments of their feeders, ate a pound of tankage for every 7.6 and 6.1 pounds of other feed, respectively. This is probably more than was needed for the most economical gains.

The pigs self-fed ground oats, shelled corn, and tankage separately made rapid and economical gains but utilized a very small amount of oats. They ate only one pound of oats for every 17.3 pounds of corn.

Shelled corn and a mixture of ground oats 4 and tankage 1 were self-fed in separate compartments of the feeder to the pigs of Lot 2. Mixing the oats with the tankage caused the pigs to take more oats but cut down the tankage consumption from 9.7 to 3.9 per cent of the ration. Possibly, by manipulating the ratio of oats and tankage, pigs could be made to consume the approximate amount of tankage needed. If the pasture is of good quality, full-fed pigs under 100 pounds in weight require about 0.25 pound of 60 per cent tankage and those over 100 pounds in weight about 0.35 pound daily a head. Apparently, pigs could not be made to eat a large percentage of oats by this method of feeding.

Lot 3 was also self-fed a mixture of ground oats 4 and tankage 1 but was hand-fed shelled corn twice daily. The pigs fed in this way took more oats than those having both corn and oats or a mixture containing oats before them in a self feeder. Furthermore, they ate more total feed, gained more rapidly, and made greater gains from a given amount of feed than those of Lot 2 which were self-fed both the mixture and corn.

Although the oats tested 36.4 pounds to the bushel, it did not pay to feed them in a way which utilized more than a very small amount.

TABLE 10.—Methods of Feeding Oats to Pigs on Red Clover Pasture

Experiment started June 30, 1931	1 Shelled corn Ground oats Tankage Self-fed, separately	2 Shelled corn Mixture of Ground oats 4 Tankage 1 Self-fed, separately	3 Shelled corn twice daily Ground oats 4 Tankage 1 Self-fed	4 Shelled corn Tankage Self-fed, separately
Acres of forage	0.5	0.5	0.5	0.5
Number of pigs	10	10	9*	10
Initial weight per pig, lb	52.6	54.1	53.9	52.9
Final weight per pig, lb	214.1	202.1	205.5	205.4
Average daily gain, lb.	**1.36**	**1.23**	**1.30**	**1.30**
Days required to gain 150 lb	111	122	116	116
Daily feed per pig, lb.:				
Shelled corn	4.04	3.94	3.89	4.17
Ground oats	0.24	0.75	0.86	.....
Tankage	0.46	0.19	0.22	0.54
Total	**4.74**	**4.88**	**4.97**	**4.71**
Feed per 100 lb. gain, lb.:				
Shelled corn	297.99	320.61	299.14	321.11
Ground oats	17.19	61.34	66.32	.....
Tankage	33.91	15.34	16.58	41.20
Total	**349.09**	**397.29**	**382.04**	**362.31**
Cost of feed per 100 lb. gain	$3.21	$3.51	$3.41	$3.35
Cost of feed and pasture per 100 lb. gain	$3.52	$3.89	$3.74	$3.68

Lot 2—A 55-lb. pig was taken out July 14.

*Lot 3—A pig which lost 8.3 lb. the first 2 weeks was figured out from the start; no feed was deducted. A 57.5-lb. pig was put in July 28.

Lot 4—A 57-lb. pig was taken out July 14 and a 54-lb. one put in July 28.

A hay crop was removed before the clover was pastured. The clover produced after a crop of hay was removed was charged at $10 an acre. Dry-rendered tankage was fed for the first 14 weeks.

COMPARISON OF FORAGE CROPS

For the first 8 weeks of the experiment all of the lots were fed approximately the same amount of concentrates daily a head and given somewhat less than a full feed. Thereafter, they were full-fed twice daily. Except for Lot 1, which was fed shelled corn and the mineral mixture given in a footnote of Table 11, the ration consisted of shelled corn and tankage. The minerals for Lot 1 were self-fed.

The ordinary alfalfa used was seeded in oats the preceding year. Otherwise, the crops were new seedings. The season of 1931 was an exceptionally favorable one for the growth of most forage crops. The rainfall was fairly abundant and was well distributed throughout the season.

Since, in other years, considerable trouble had been experienced with weeds in seedings of sweet clover and Peruvian alfalfa made in April or in the fore part of May, after the ground had been plowed and prepared, seeding winter wheat at the rate of one-half bushel per acre with these crops was tried. Weeds were not a problem in the dry season of 1930 when the sweet clover was seeded early on ground prepared in the fall. Winter wheat seeded in the spring does not head out but remains green until about the middle of July and then gradually dies out. Thus, it not only helps to keep down the weeds but also provides excellent forage during the early part of the grazing season.

Peruvian alfalfa is a rapid growing strain from Arizona which usually winter-kills in the North. When used like sweet clover for pasturing the same season it is seeded, whether or not the alfalfa winter-kills is immaterial. It provided more forage and produced faster and more economical gains than white sweet clover.

At the end of the ninth week the soybean pasture on the original plot was practically exhausted. The pigs were then moved to a one-eighth acre plot of beans and the half acre was reseeded. Rains at an opportune time caused the second seeding to germinate and make a good growth for that season of the year. After 4 weeks the pigs were put back on the original plot which then furnished green feed until the close of the test.

Sudan grass looks spindling at first, but, if the seeding is reasonably heavy, it soon provides an abundance of forage. In order to keep it from becoming too rank and to cause it to produce new growth, clipping the Sudan grass a time or two during the season is advisable. A half of the plot in this test was clipped at one time and the other half about 2 weeks later. Although Sudan grass seems to be fairly palatable, it has been less valuable than alfalfa, red clover, rape, Peruvian alfalfa, and soybean pasture for pigs. Like soybeans it is killed by frost.

A ration of corn and minerals for pigs on alfalfa would probably not make as advantageous a showing in comparison with one of corn and tankage if the season were less favorable or if the pigs were started at a lighter weight.

TABLE 11.—Comparison of Forage Crops

	1 **Alfalfa** Shelled corn Minerals	2 **Alfalfa** Shelled corn Tankage	3 **Sweet clover with Winter wheat** Shelled corn Tankage	4 **Peruvian alfalfa with Winter wheat** Shelled corn Tankage	5 **Soybean pasture** Shelled corn Tankage	6 **Sudan grass** Shelled corn Tankage	7 **Rape** Shelled corn Tankage
Acres of forage	0.5	0.5	0.5	0.5	0.625	0.5	0.5
Number of pigs	10	10	10	10	10	10	10
Initial weight per pig, lb.	63.7	63.9	63.8	64.4	64.3	63.8	63.4
Final weight per pig, lb.	212.7	210.2	201.6	207.4	200.9	205.7	204.2
Average daily gain, lb.	**1.25**	**1.36**	**1.15**	**1.28**	**1.22**	**1.19**	**1.19**
Days required to gain 150 lb.	120	111	131	118	123	126	126
Daily feed per pig, lb.:							
Shelled corn	4.59	4.39	4.35	4.34	4.33	4.49	4.14
Tankage		0.22	0.24	0.23	0.22	0.23	0.24
Minerals	0.03						
Total	**4.62**	**4.61**	**4.59**	**4.57**	**4.55**	**4.72**	**4.38**
Feed per 100 lb. gain, lb.:							
Shelled corn	366.66	322.35	378.19	340.15	354.76	376.18	348.88
Tankage		16.28	20.66	18.00	18.45	19.66	19.79
Minerals	2.72						
Total	**369.38**	**338.63**	**398.85**	**358.15**	**373.21**	**395.84**	**368.67**
Cost of feed per 100 lb. gain	$3.02	$2.91	$3.44	$3.09	$3.21	$3.41	$3.19
Cost of feed and pasture per 100 lb. gain	$3.55	$3.58	$4.01	$3.91	$3.91	$3.97	$3.72

Lot 2—A 95.5-lb. pig died July 7; a 63.5-lb. one was taken out on June 23.
Lot 3—An 89-lb. pig was taken out on July 7.
Lot 7—An 84-lb. pig choked to death June 23; an 81-lb. one was put in its place June 30.
Minerals for Lot 1: Salt, 18.4; limestone, 36.8; special steamed bone meal, 36.8; iron oxide, 2.8; anhydrous copper sulphate, 0.2; potassium iodide, 0.03; molasses, 4.97.

A charge of $13 an acre was made for rent on the land and preparing the seedbed. With the exception of allowing $1.50 an acre for cultivating the rape, the charge of $13 an acre, plus the cost of the seed, made up the pasture charge. The alfalfa was figured at $16 an acre. The seed consisted of soybeans, 2.25 bu. @ 60¢; sweet clover, 7.5 lb. @ 7.5¢; and winter wheat, 1 peck @ 15¢; Peruvian alfalfa, 12 lb. @ 25¢; and winter wheat, 1 peck @ 15¢; Sudan grass, 15 lb. @ 10¢; dwarf Essex rape, 2.5 lb. @ 10¢.

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